

Logistics Warehousing / Storage



Shipping & Receiving



Depot Operations



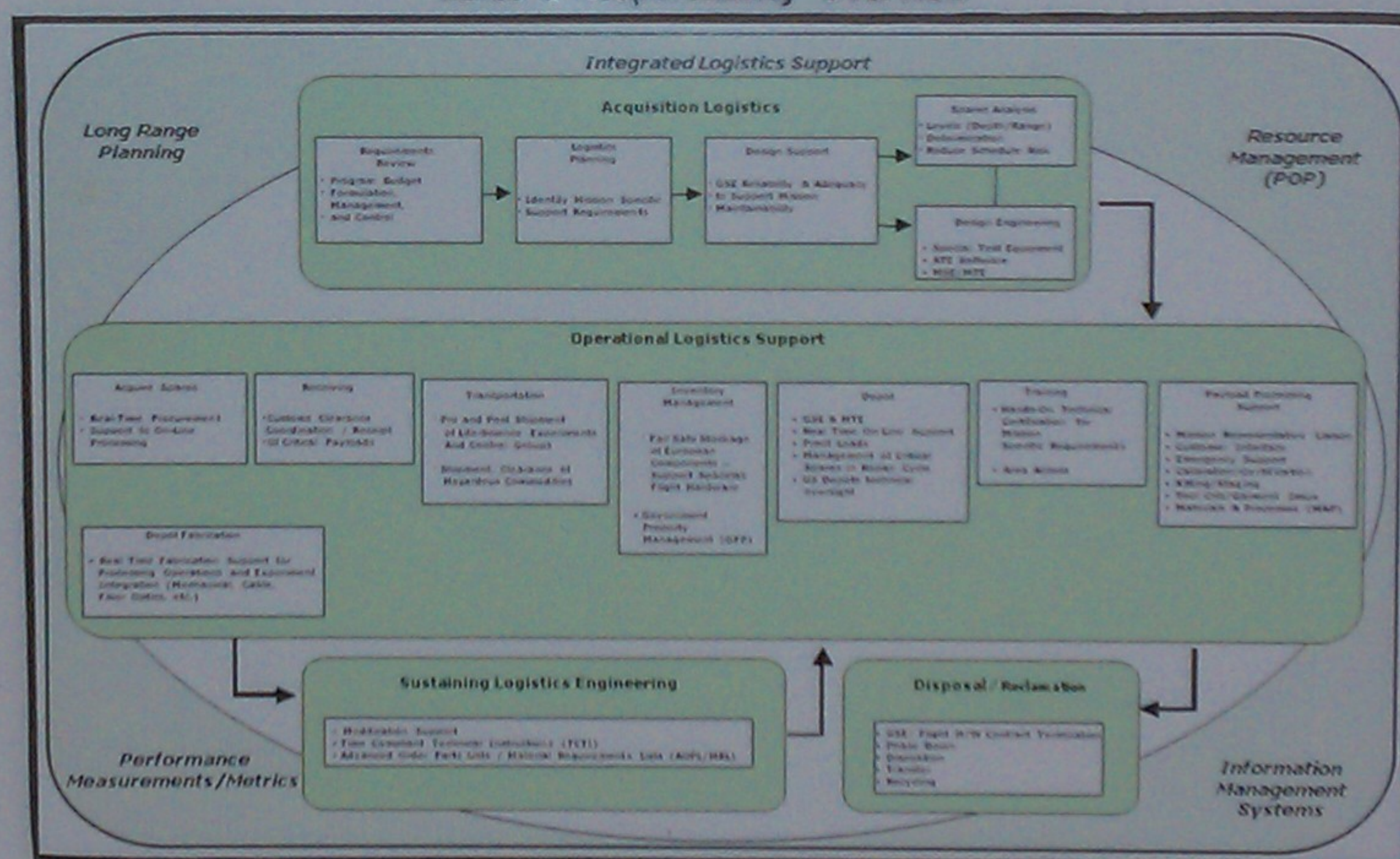
Toneka Rogers – Jackson State University USRP Intern

Project Title: ISS Logistics Hardware Disposition and Metrics Validation

I was assigned to the Logistics Division of the International Space Station (ISS)/Spacecraft Processing Directorate. The Division consists of eight NASA engineers and specialists that oversee the logistics portion of the Checkout, Assembly, and Payload Processing Services (CAPPS) contract. Boeing, their sub-contractors and the Boeing 10K contract out of Johnson Space Center, provide the Integrated Logistics Support for the ISS activities at Kennedy Space Center. Essentially they ensure that spares are available to support flight hardware processing and the associated ground support equipment (GSE). Boeing maintains a Depot for electrical, mechanical and structural modifications and/or repair capability as required. My assigned task was to learn project management techniques utilized by NASA and its contractors to provide an efficient and effective logistics support infrastructure to the ISS program. Within the Space Station Processing Facility (SSPF) I was exposed to Logistics support components, such as, the NASA Spacecraft Services Depot (NSSD) capabilities, Mission Processing tools, techniques and Warehouse support issues, required for integrating Space Station elements at the Kennedy Space Center. I also supported the following hand-on activities: identification of near-term ISS Hardware and Ground Support Equipment (GSE) candidates for excessing/disposition prior to October 2011, and validation of several Logistics Metrics used by the contractor to measure logistics support effectiveness.

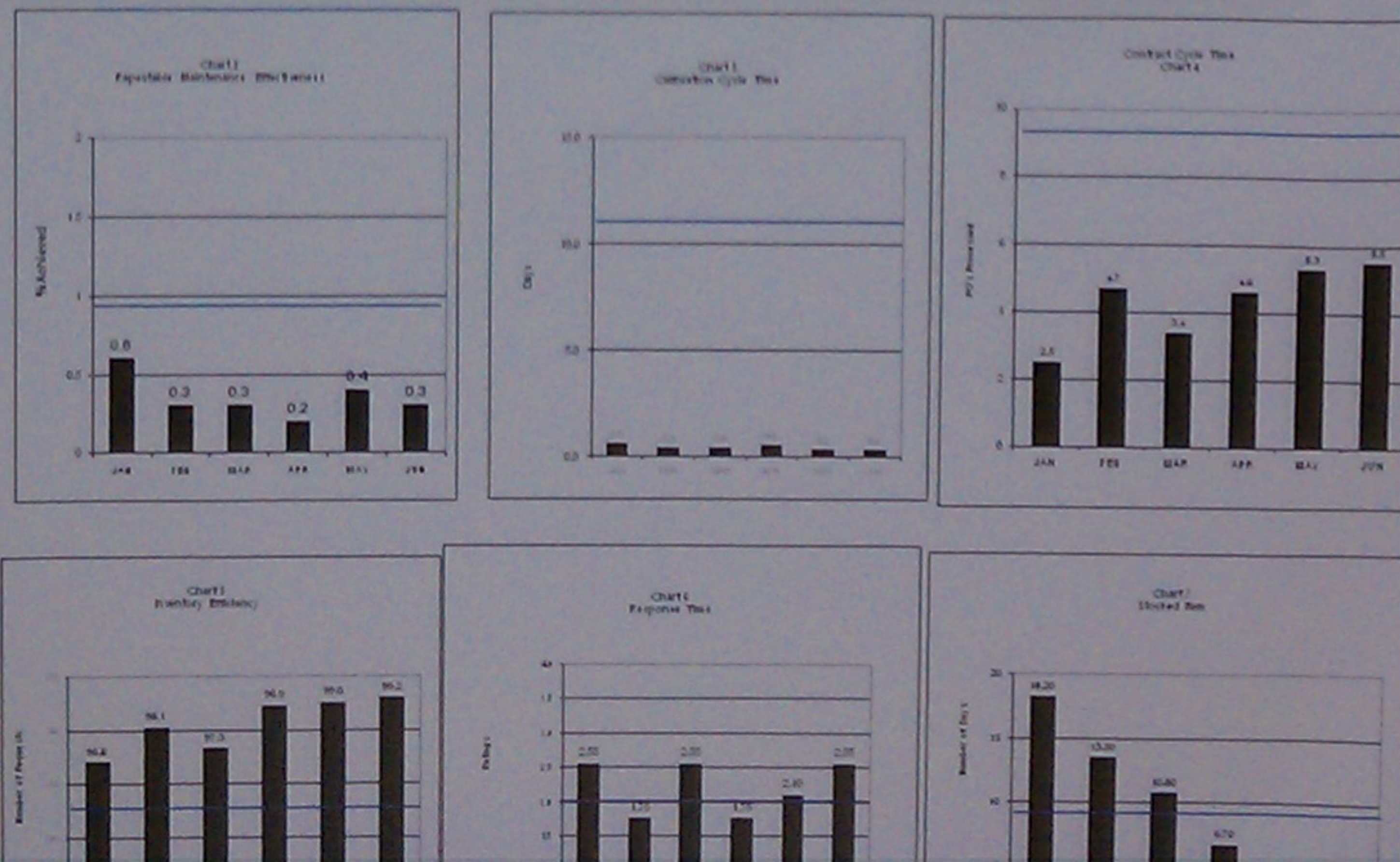


Logistics Management and Operations Roles & Responsibility Overview

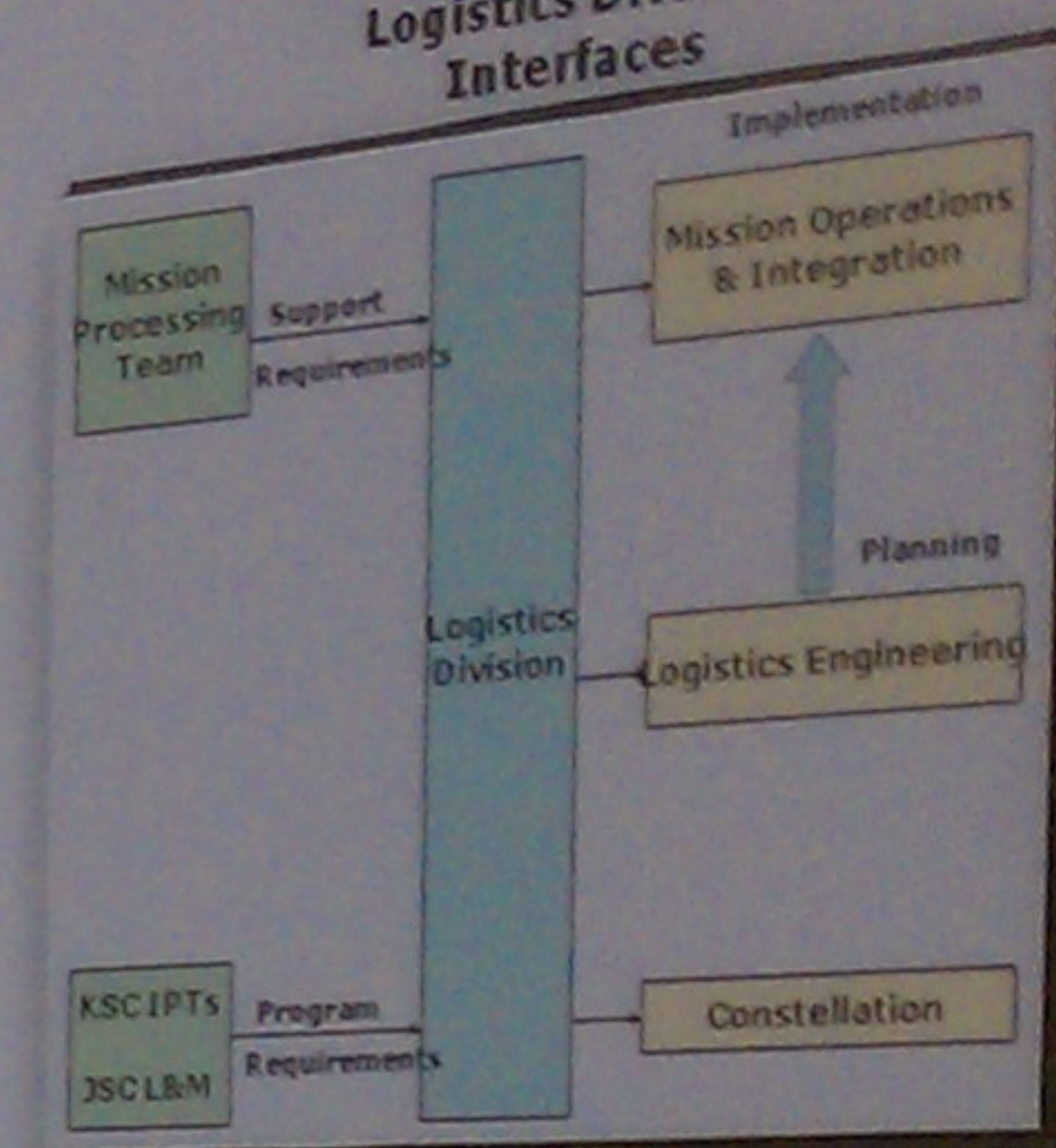


Metric Description
These monthly metric examples provide management visibility of key Logistics Program performance measures and aggregates their contributions to provide an overview of a Logistics program operations.

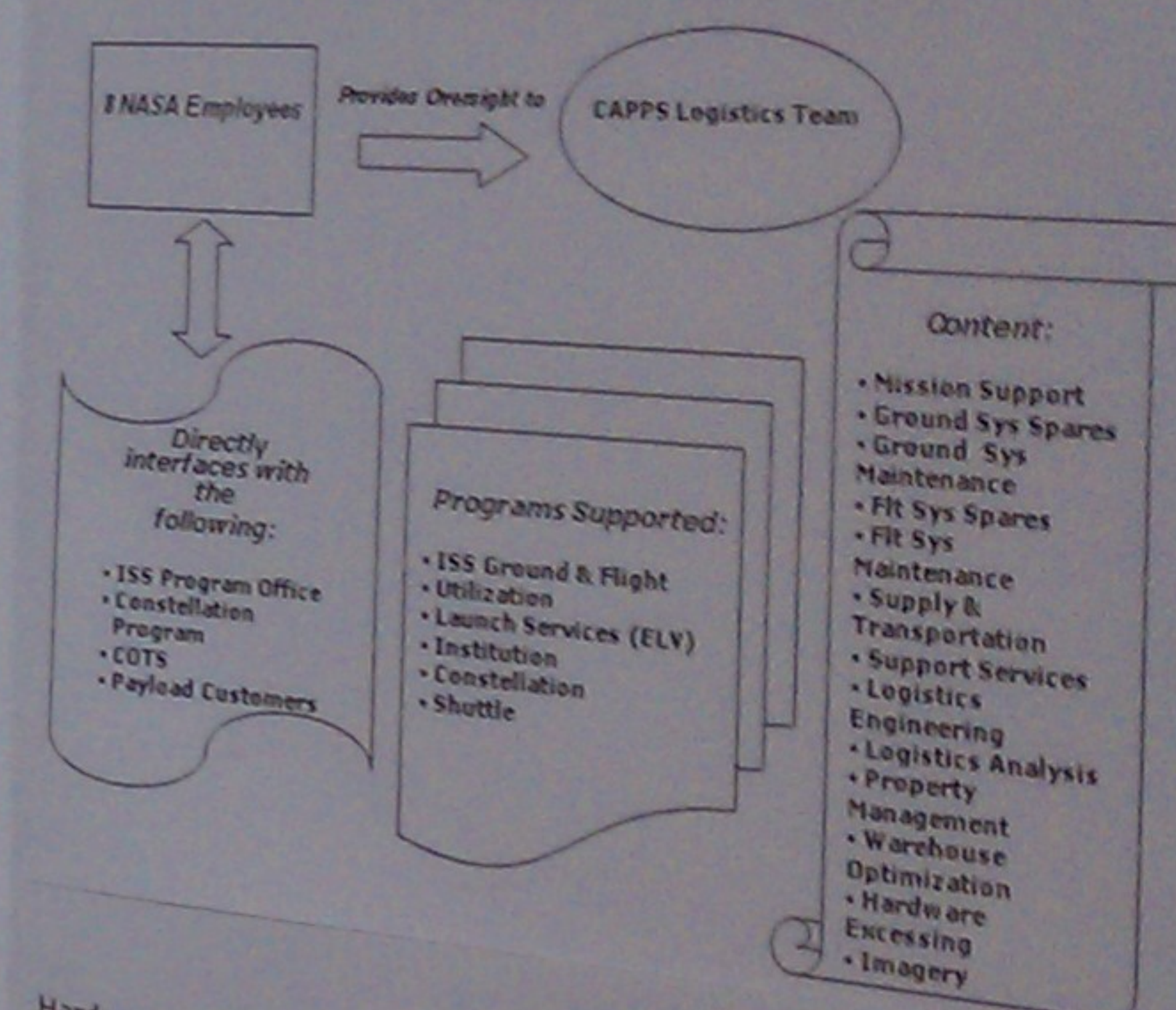
Chart 2: Monthly maintenance calibration rate based on number of active items in system
Chart 3: The average time a item will spend being calibrated.
Chart 4: The monthly avg. elapsed time to issue a PO
Chart 5: The monthly % of customer demand orders filled as a measure of items available for issue.
Chart 6: Response Time for Specified Jobs.



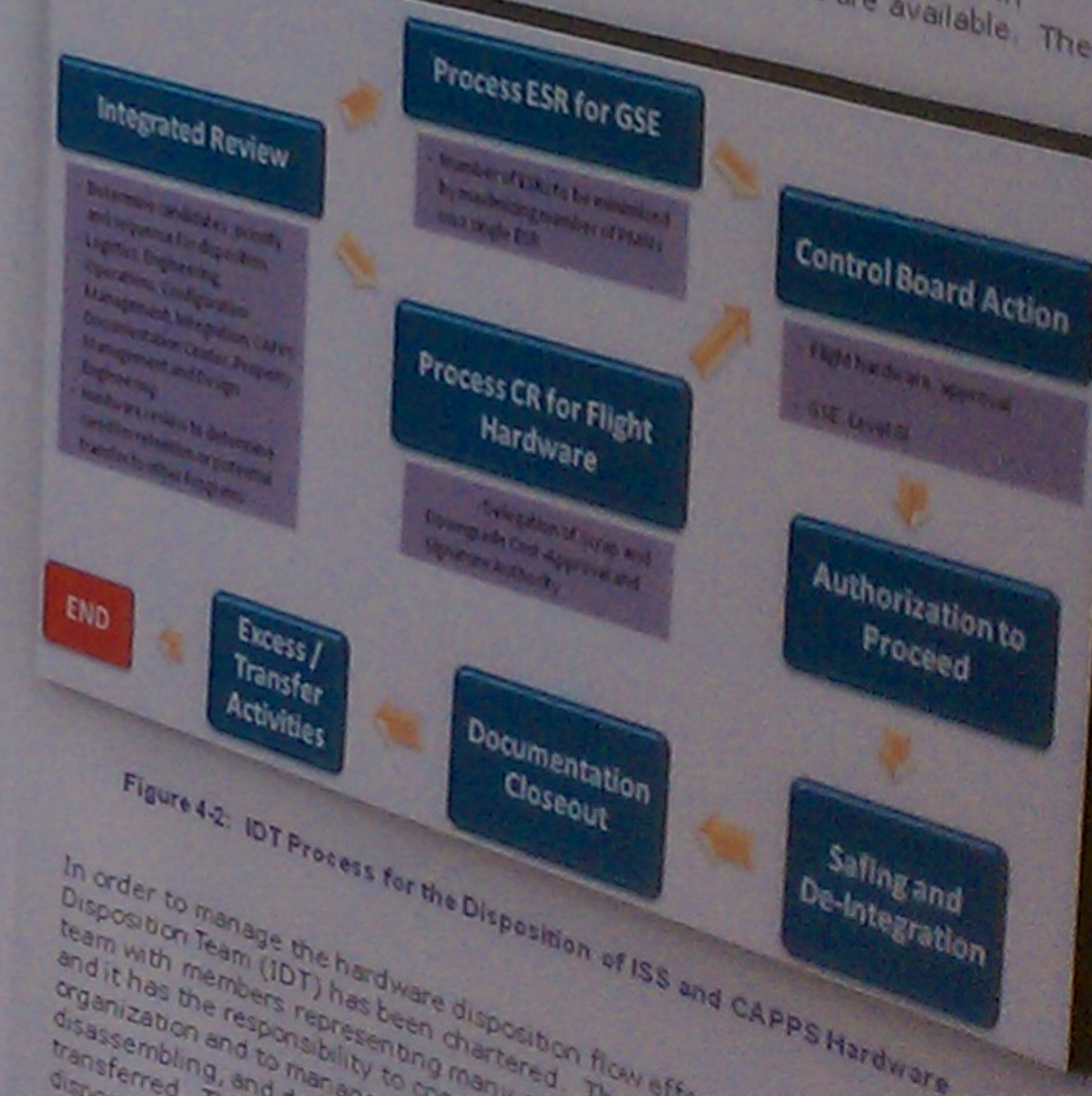
Logistics Division Interfaces



Logistics Division Function



Hardware Disposition
Another major effort to be undertaken during FY11, FY12, and the final two years of the ISS Program is the disposition of any ISS hardware in the operational and warehouse areas that is deemed to have no future use. This effort is known as the "bow wave disposition," and it involves several thousand line items of Ground Support Equipment (GSE) and flight hardware. While an adequate process had been in place to handle routine disposition, the sheer volume of hardware to be processed has necessitated some innovation. The process will also expedite the transfer of hardware to other NASA projects in order to make sure that best opportunities to re-use hardware are available. The disposition process is illustrated in Figure 4.2.



ISS Logistics Hardware Disposition and Metrics Validation

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Abstract

I was assigned to the Logistics Division of the International Space Station (ISS)/Spacecraft Processing Directorate. The Division consists of eight NASA engineers and specialists that oversee the logistics portion of the Checkout, Assembly, and Payload Processing Services (CAPPS) contract. Boeing, their sub-contractors and the Boeing Prime contract out of Johnson Space Center, provide the Integrated Logistics Support for the ISS activities at Kennedy Space Center. Essentially they ensure that spares are available to support flight hardware processing and the associated ground support equipment (GSE). Boeing maintains a Depot for electrical, mechanical and structural modifications and/or repair capability as required. My assigned task was to learn project management techniques utilized by NASA and its' contractors to provide an efficient and effective logistics support infrastructure to the ISS program. Within the Space Station Processing Facility (SSPF) I was exposed to Logistics support components, such as, the NASA Spacecraft Services Depot (NSSD) capabilities, Mission Processing tools, techniques and Warehouse support issues, required for integrating Space Station elements at the Kennedy Space Center. I also supported the identification of near-term ISS Hardware and Ground Support Equipment (GSE) candidates for excessing/disposition prior to October 2010; and the validation of several Logistics Metrics used by the contractor to measure logistics support effectiveness.

I. Introduction

During my ten-week internship, I was exposed to several aspects of logistics that help to facilitate the integration and maintenance of the International Space Station. My first assignment involved validating several metrics used for monitoring the effectiveness of several functions performed by the CAPPS logistics infrastructure. These metrics help to ensure the smooth flow of materials needed for ISS. Furthermore, I was given the opportunity to visit several warehouses and the NASA Spacecraft Services Depot (NSSD). The Integrated Disposition Team also provided the opportunity for me to shadow them during their pre-disposition process. I have been involved in identifying candidates for excessing/disposition that is due to begin October 2010. I also took part in the 2010 Minority Student Education Forum, in which I participated as an advisee in near-peer round table sessions alongside other Ambassadors, University, and INSPIRE interns. This paper will further explain and describe my experiences during my 2010 NASA Internship.

II. ¹Post Shuttle Concept of Ops Logistics Support

Overview

The logistics system for UB is based on an Integrated Logistics System (ILS), which integrates and manages multiple logistics disciplines in order to achieve mission success. One of the most visible of these logistics functions is material management (packing, handling, storage, and transportation), but an ILS system encompasses many other areas. These areas include Maintenance and Repair, System Supportability, Technical Training, and Imagery, Procurement, and Logistics Mission Processing Support. The Logistics Division is also responsible for the NASA Spacecraft Services Depot (NSSD), where flight hardware repair and fabrication capabilities are located. The Logistics Division faces a greater workload over the next two years. One of the driving factors will be the receiving and storage of a vast array of hardware that will be arriving from the Original Equipment Manufacturers (OEMs) who designed and built the Orbital Replacement Units (ORUs) for the ISS program. In addition, Logistics will plan the timely and accurate disposition of thousands of individual pieces of hardware assets which are no longer required due to Space Shuttle Retirement. Finally, Logistics will have the additional responsibility to deliver flight hardware to launch sites at Tanegashima, Japan; Kourou, French Guiana; and Wallops Island, Virginia.

¹ Post Shuttle Concept of Operations Plan, KSC-PLN-2003 basic rev., dated 23 June, 2010, pgs. 15-18

Logistics Operations

Material Management provides for the acquisition, receipt, distribution, and accountability of materials and services required supporting payload processing activities. Besides the MM function, Logistics Operations include Transportation, Warehousing, Inventory and Government Property Management, Mission Support, and Fleet Resource Management. Many of these functions are essential to all activities that UB performs, and their functions will not change significantly in the post-Shuttle timeframe; however, a change in volume is expected in certain areas such as Mission Support, Fleet Resource Management and Logistics Engineering. Also, new activities such as disposition and storage and monitoring of OEM hardware will offset these reductions in scale.

Transportation encompasses shipping and receiving, payload upload and off-load coordination, transport between KSC or Cape Canaveral Air Force Station (CCAFS) facilities, and coordination of carrier fueling with the Institutional Services Contract (ISC). The transportation team will be responsible for delivering KSC-processed flight hardware to the launch sites of the International and Commercial Partners. They also construct shipping containers to protect and insure the integrity of any hardware that needs to be transported.

Inventory Management: The UB contractor manages an integrated supply system of all flight and non-flight spare parts, repair parts, supplies, and materials. They are responsible for ensuring the necessary items are available for use when they are needed. They track spare parts and stock spares when there is a likelihood that a part will be difficult to obtain and be needed in the future. Finally, they maintain government property records in accordance with the NASA Integrated Asset Management System (IAMS). The Inventory Management personnel will be responsible for documenting and cataloguing the OEM hardware due to arrive over the next few years. They will also assist the Integrated Disposition Team with the identification and disposition of assets no longer required for use.

Warehousing maintains inventory in a 'ready to use' condition. The warehouse personnel are responsible for stocking, storing, and issuing hardware in support of flight, GSE, and cranes and doors. They maintain records of all items in the warehouses, their specific locations, and the amount of space available/occupied.

Kitting personnel provide support to the operational areas during flight hardware processing. They are responsible for providing parts, tools, equipment, and material in accordance with Work Authorization Documents (WAD). They also issue loan-pool equipment from the Instrument Library and other Tool Crib areas. They distribute and track clean room garments, as well as other protective garments, in several operational areas. In addition, the Instrument Library and Tool Cribs provide bench stock consumable items such as plastics, foams, adhesives, and cleaning materials.

OEM Hardware Cataloging and Storage

Part of the ISS transition from construction to utilization involves shutting down the construction supply chain for many of the ORUs that have been built. The program will do this in order to minimize the costs associated with continued maintenance of the ISS. While the program has provided for many spares on-orbit, it is still foreseeable that an ORU will fail and require a repair or replacement. Because of this need to repair ORUs and because the Original Equipment Manufacturers (OEMs) will not be operating in that capacity, UB will be responsible to store ORUs, parts, and related equipment used by the OEMs, and may have to perform repairs as-needed according to program direction.

UB Logistics has developed and used the process for accepting OEM hardware; however, the workload in this regard is expected to increase substantially over the next several years. There will be several thousand line items of hardware arriving, and these items have the potential to occupy more warehouse space than is forecast to be available. The current plan is to utilize other ISS facilities (e.g., SSPF areas, Butler Building) to store any OEM warehouse overflow.

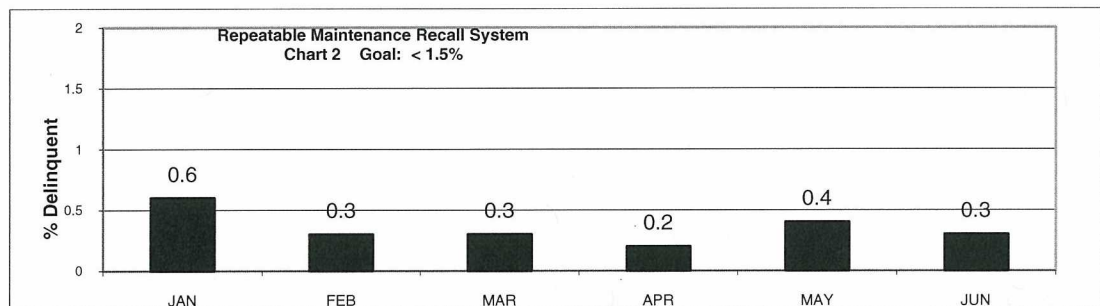
KSC will have to work with the Logistics & Maintenance group at Johnson Space Center (JSC), and place an emphasis on the "pre-screening" of hardware before it is shipped. This will be necessary in order to avoid repeating the problems experienced during past OEM closeouts, when more hardware than predicted made its way to KSC, and KSC ended up bearing the cost of excessing this OEM hardware. A set of metrics will be used to identify problems at the time of receiving (e.g., shipping documentation discrepancies, lacking shipping documentation and/or information, incomplete shipments, much larger shipments than communicated/agreed); and to determine who, when, and where to send KSC personnel in order to help resolve any problems at OEM site before hardware is shipped to KSC. Managing resources effectively will be the key to the success of this operation.

III. CAPPS Logistics Metrics Validation

The Logistics Division (UB) at Kennedy Space Center oversees the contractor's logistics operations for the International Space Station. These operations are only a portion the Checkout, Assembly, and Payload Processing Services (CAPPS) contract.² The CAPPS Contract primarily performs payload checkout, assembly, integration and processing activities for International Space Station (ISS). It also provides some auxiliary services to the Shuttle, Constellation, and Expendable programs consistent with Kennedy Space Center (KSC) designated responsibilities. The effectiveness of these logistics operations are rated by several metrics. These metrics are updated monthly, and provides management visibility of the key Logistics Program performance measures and aggregates their weighted contributions to provide an overview of the CAPPS Logistics program operations.

- A. ³**Repeatable Maintenance Recall System**-provides snap shot of CAPPS Cyclic Maintenance delinquency rate. Delinquent trends are typically used in industry to gage the health of recall systems. The data is a composite of all the RMRS user groups' delinquent rates. User groups include: ISS, MMSE, Facilities, etc. The managers in the respective areas, as well as CAPPS Quality, receive weekly delinquent listing to help them in reducing delinquencies. Calculation: divide total number delinquent by number of active items in a system.

Validation: This metric was validated using the Weekly Synopsis Reports generated for the month of May. Each report provided a listing of the number of delinquent items by disciplines with subtotals for each category. A corresponding delinquent rate for the week is calculated by the system. The final delinquent rate generated for the month is an average of these weekly delinquent rates. Thus for the month of May this percentage was 0.4. This is in line with the goal of <1.5%.



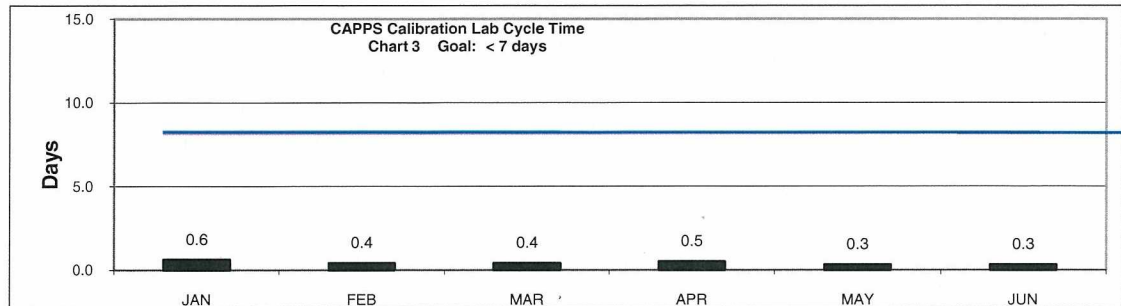
- B. ⁴**CAPPS Calibration Lab Cycle Time**-shows the average time an item spends in the CAPPS Calibration Laboratory in calendar days. Calculation: Cycle time commences when an instrument enters the calibration laboratory and ends when the calibration certificate is completed, the item cleaned, sealed, labeled and sent to RMRS for return to the customer. Goal: less than 7 days.

Validation: This metric was validated for the month of May by analyzing an IN-Place Calibration report from Jacobs Technologies. This particular report had 38 line items that were sent in to be calibrated and returned. The sum of the cycle time for these 38 items added up to a total of 12 days. I divided the 12 by 38 to arrive at an average of 0.3 days for calibrations. This falls within the goal for lab cycle times, and is recorded accurately according to the data I analyzed.

² Overview of the Checkout, Assembly, and Payload Processing Services (CAPPS) Contract, Integrated Logistics Report, dated 22 Jan, 2010, pg 2

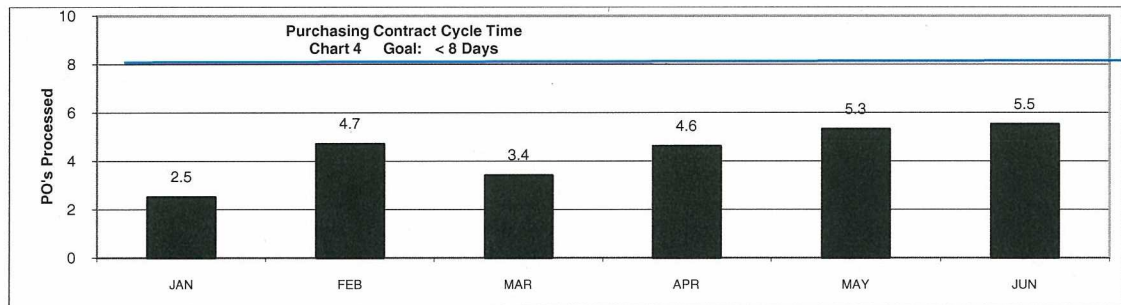
³ Jacobs-Repeatable Maintenance Recall System, Osrmsr-FY10.xlsx, dated 6 July, 2010

⁴ Jacobs H243, Gs_Cal_cyctmMay10.xlsx, dated 01 June, 2010



- C. ⁵**Purchasing Contract Cycle Time**-shows the elapsed time between Procurement's receipt of a Purchase Request (PR) to the issuance of the actual Purchase Contract (PC). Calculation: total number of business days for each completed procurement, divided by the number of orders placed. Goal: less than 8 days.

Validation: This metric was validated by referencing a report that records the cycle time for all items with a completed purchase date in May. I counted 147 line items, with a total of 770 cycle days. By dividing 770 by 147, the average for May should have been 5.2 days. This metric revealed an error, and it was discovered that the number of days counted and the number of days that were used to create the metric for this month differed. Calculations were made using 150 line items instead of the 147 that were documented. Despite the inaccuracy, this goal still fell within the goal of <8 days.

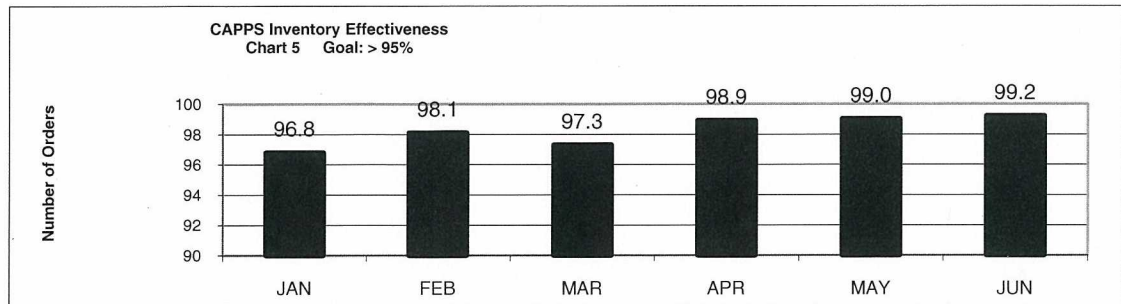


- D. ⁶**CAPPS Inventory Effectiveness**-displays CAPPS issue requests for items stocked versus those available for issue. The calculated percent is based on the availability of stock upon customer demand. Calculations: total number of line items issued to customers divided by the total number of customer orders. Goal: greater than 95%.

Validation: This metric was validated by using data gleaned from three report categories (open request orders, orders in reserve and orders completely closed). These reports recorded the total number orders and the total number of items for the month of May for both flight and non-flight items. In May, 501 items were ordered, and 496 items were issued. 496 divided by 501 is .99. Therefore 99% of orders were filled. This metric proved to be accurate for the month of May.

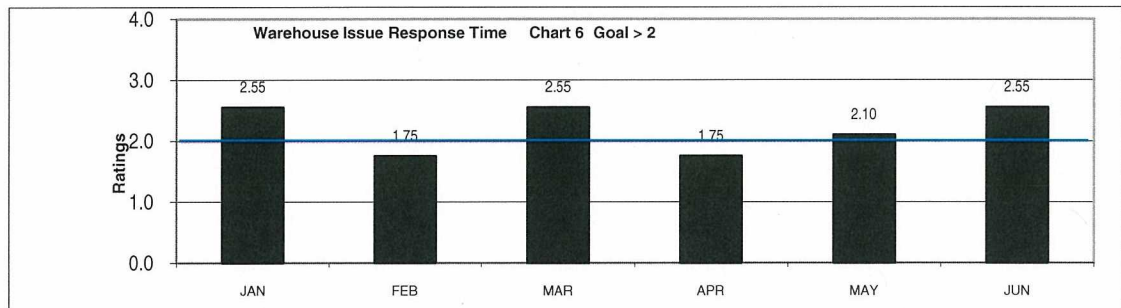
⁵ Subcontract Management Purchase Contract Cycle Time Metric Reporting, DI-CCT-001 basic rev, 07 March, 2007

⁶ Inventory Management Inventory Effectiveness (Fill Rate) Metric Reporting, DI-IM-025 basic rev, 09 March, 2007



- E. ⁷**Warehouse Issue Response Time**-depicts the overall performance of issue response times for priority 2, 5, and 12 requests through composite factoring. Calculation: Individual priority categories are graded and assigned weights for composite factoring. Priority 2-20%, Priority 5-35%, Priority 12-45%. Goal: greater than 2.

Validation: Issue Response Time for the month of May was validated using response time data calculated on an excel spreadsheet. The average issue response time was calculated for three priority categories based on total response time and number of issues. The average time is compared to a target value of 2 hours for Priority 2, 6 hours for Priority 5 and 12 hours for Priority 12 and a specific rating is assigned to each priority category (from 1 to 3). Also, each category is assigned a weight factor with all three totaling a value of 1. The weight for priority 2 is .200, priority 5 is .350, and priority 12 is .450. If you multiply .200 by its rating of 3, the issue response time for priority 2 is .60 days. The issue response time for priority 5 is 1.05 days when you multiply .350 by its rating of 3. Priority 12's response time is .45 days when you multiply .450 by its rating of 1. Adding up all the priorities gives an overall issue response time of 2.10 for the month of May. This falls right on target for the goal of >2.

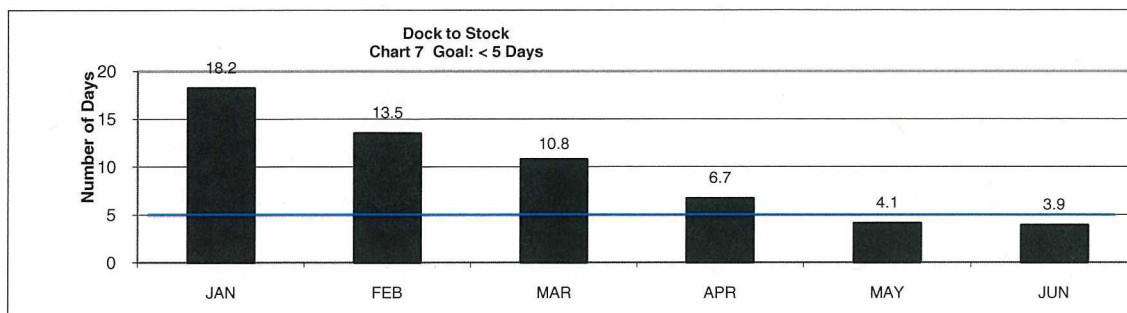


- F. ⁸**Dock to Stock**-the monthly average through-put time of material from the time of receipt until it is delivered, and stocked. Goal: less than 5 days. Calculation: The Material RDPCT (Receipt & Disposition Processing Cycle Time) is the sum of the total average receipt processing time and the total average time to stock items, including delivery to the warehouse.

Validation: I was able to validate this metric by analyzing the Dock to Stock Metric chart that recorded the average stock response time (2.0) and the total average receipt processing time (2.1). By adding these two numbers, I verified the (RDPCT) to be 4.1 days for the month of May. This falls within the goal of <5 days.

⁷ Warehousing Issue Response Time, WDT M001 basic rev, 27 March, 2007

⁸ Receiving Dock-to-Stock Metric Reporting, DI-REC-001 basic rev, 21 February, 2007



IV. ⁹NASA Spacecraft Services Depot/ Warehousing



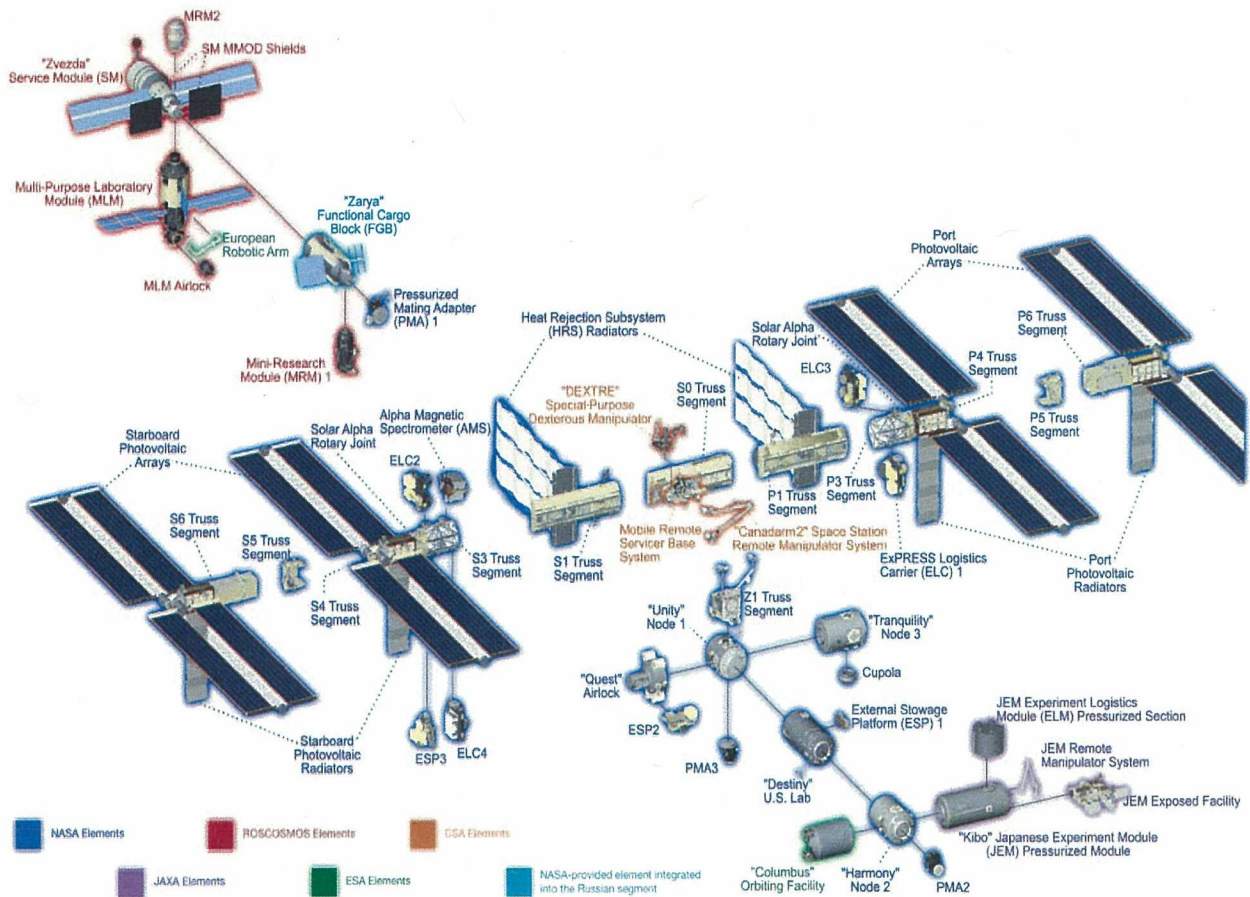
NASA Spacecraft Services Depot (NSSD) is located in close proximity to where the hardware is stored, inspected, tested, and processed. The NSSD exists to combine a highly-skilled workforce with the tools and resources needed to service flight and ground support hardware. The NSSD provides flight hardware and GSE maintenance, repair, and calibration. The NSSD also performs fabrication, modification, testing and repair of fiber and copper cables, MLI products, mechanical and structural hardware, and a wide range of electronic units. The NSSD supports the Repeatable Maintenance Recall System (RMRS), which is used to schedule and track calibration requirements and other preventive maintenance tasks (including

proof-loading of lifting equipment). The NSSD also provides support to the Launch Services Program and other programs performing work at KSC in addition to the ISS Program.

V. International Space Station

The space station is located in orbit around the Earth at an altitude of approximately 360 km (220 miles), a type of orbit usually termed low Earth orbit. It orbits Earth in a period of about 90 minutes; by August 2007 it had completed more than 50,000 orbits since launch of Zarya on November 20, 1998. A total of 14 main pressurized modules are scheduled to be part of the ISS by its completion date in 2010. A number of smaller pressurized sections will be adjunct to them (Soyuz spacecraft (permanently 2 as lifeboats - 6 months rotations), Progress transporters (2 or more), the Quest and Pirs airlocks, as well as periodically the Multi-Purpose Logistics Module, the Automated Transfer Vehicle and the H-II Transfer Vehicle). The ISS, when completed, will consist of a set of communicating pressurized modules connected to a truss, on which four large pairs of photovoltaic modules (solar panels) are attached. The pressurized modules and the truss will be perpendicular: the truss spanning from starboard to port and the habitable zone extending on the aft-forward axis. Although during the construction the station attitude may vary, when all four photovoltaic modules are in their definitive position the aft-forward axis will be parallel to the velocity vector. In addition to the assembly and utilization flights, approximately 30 Progress spacecraft flights are required to provide logistics until 2010. Experimental equipment, fuel and consumables are and will be delivered by all vehicles visiting the ISS: the Shuttle, the Russian Progress, the European ATV and the Japanese HTV.

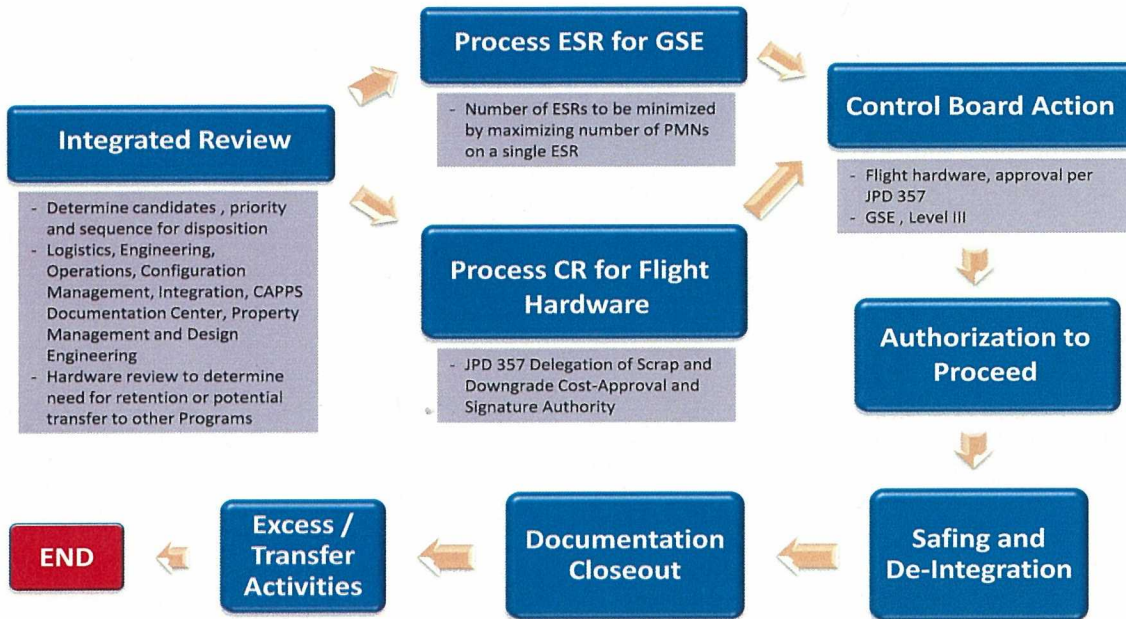
⁹ Post-Shuttle Concept of Operations Plan, KSC-PLN-2003 basic rev, 23 June, 2010, pg 18



VI. Integrated Disposition Team

The International Space Station's Completion will mark the end of the Shuttle Program here at KSC. With this program ending, there will be a great amount of materials that need a new home.¹⁰ During FY11, FY12, and the final two years of the ISS Program the disposition of any ISS hardware in the operational and warehouse areas that is deemed to have no future use will need to take place. This effort is known as the "bow wave disposition," and it involves several thousand line items of Ground Support Equipment (GSE) and flight hardware. While an adequate process had been in place to handle routine disposition, the sheer volume of hardware to be processed has necessitated some innovation. The process will also expedite the transfer of hardware to other NASA projects in order to make sure that best opportunities to re-use hardware are available. In order to manage the hardware disposition flow effectively, the Integrated Disposition Team (IDT) has been chartered. The IDT is a multidisciplinary team with members representing many contractor and NASA organizations, and it has the responsibility to coordinate disposition efforts across the organization and to manage the flow of resources used in the moving, disassembling, and documenting of the hardware to be excessed or transferred. The IDT will maintain a database of hardware candidates for disposition, and they will construct a detailed schedule showing when each individual subsystem and assembly is scheduled for disposition. The IDT will give particular attention to clearing out large items in the operational areas and the warehouses to maximize the amount of space available for other projects and missions. With the coordination of the IDT, the huge volume of hardware to disposition will be managed effectively.

¹⁰ Post-Shuttle Concept of Operations Plan, KSC-PLN-2003 basic rev, 23 June, 2010, pgs 20-21



My participation in this process involved scrubbing the master list of items. I reviewed the updated appendices and compared them to the master lists. If the master list contained items that were not in the updated appendices, I identified the items, and action was taken to remove it from the list. This aided the team in minimizing the overall list of items that needed to be reviewed, as well as remove excessive data. I attended several tag-up meetings that addressed the disposition process and scheduling. I, along with several members of the team visited two of the warehouses to start identifying candidates. My latest assignment was to attend an IDT Hardware Screening Meeting. This meeting was the first step to scrub the edited appendices and discuss any concerns or disagreements about the candidates. I acted as the driver during this meeting, and I scrubbed the appendix being reviewed as well.

VII. Conclusion

In my time at NASA, I have been able to experience both behind and on the scenes action and support for our Space Programs. I was fortunate enough to have met various astronauts, center directors, and civilian workers that have helped to create and maintain various missions. I've gotten hands on experience in the Logistics Department under the ISS/Spacecraft Processing Directorate at KSC. I have been involved in different tasks and projects that I never imagined ever being a part of. From the viewing of different shuttles, rockets, vehicles and hardware, I can truly walk away from this experience with more understanding, respect, and support for what our country has done relative to space exploration in the past and for the upcoming future.